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Our Forest Resources



Forests of the Future

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As the United States becomes more urbanized and affluent, and its society more specialized, it has become easier to take for granted the adequacy of its food and fiber supply. Perhaps nowhere is this more obvious than in the lack of consideration and appreciation of the contributions of our forests. The connection is rarely made that writing paper, houses, and furniture are usually made from raw materials supplied by forests. Nor is the link made between water supply or enjoyment of wildlife, or the esthetic quality of the outdoor environment to the condition of the forests.

Perhaps one of the great luxuries of our affluence is not having to worry about the Nation's potential to grow food or fiber. This is in striking contrast to parts of the world where years of misuse of the forests, accompanied by less favorable rainfall than ours, has brought in wood fuel shortages, the destruction of watersheds, and even climate changes.

These problems are geographically distant from the United States, but it would be wrong to assume that there will always be enough forests of the right kind in North America, or that this Nation will not be affected by shortages of such resources elsewhere in the world.

Forests—A Renewable Resource

One outstanding characteristic of the forest resource is its renewability. Unlike many of the possible substitutes

for wood, a forest can be grown, harvested, and regrown. In some respects, consumers can have their cake and eat it again in a few decades. This contrasts sharply with the nonrenewability of mineral resources such as coal, or steel, or other commodities used for fuel or construction.

Renewability has two important consequences. First, through science and management, people can influence the long-term supply of forest products made available. Second, because supply can be manipulated, long-term demands on renewable forest resources are likely to increase substantially relative to the fixed supply of nonrenewable resources—that is, along with the normal growth in demand from increases in population and overall economic growth, increased substitution of forest resources for nonrenewable resources must be watched.

The Long-Term Character of Forestry

To examine the needs for, and contribution of, research on forest resources, it is necessary to look beyond the requirements of next season or even next year. The time between planting a forest stand and harvesting its products ranges from almost a decade to a century. The impacts of many forest management practices may not be fully realized for 10 years or so. Similarly, investing in research does not provide quick payoffs.

A study of the contributions of research to forestry by the Forest Service a few years ago pointed out two important conclusions: (1) The returns from investment in research are unexpectedly high, and (2) the time from the inception of a researchable idea to the implementation of research findings averages well over a decade.

The need to look beyond the turn of the century to evaluate the needs



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Forests provide scenic beauty, basic raw materials for many products, a link to our water supply, and a home for wildlife.

for forest resources and the implications for research is of considerably more than academic interest. Taking the long view is necessary in formulating informed investment strategies.

Some Future Trends

Investigators have delineated several trends that will influence the demand on forest resources over the next couple of decades and from which conclusions about the adequacy of these resources can be drawn.

It is absolutely necessary to think in global terms. While there will be continuing political debate over the extent to which free trade or protectionism vis-à-vis global interdependence should be encouraged or discouraged, evidence overwhelmingly points to the conclusion that increasing the sharing of resources and technology would lead to a world both

economically better off and more secure and stable. In this belief, the discussion of the following trends moves freely between domestic and global considerations.

- **Domestic and global population growth will increase demands on forest resources.**

Recognizing that the rate of population increase has been declining both in the United States and the world, medium-level estimates indicate that the United States will have 260 million people by the turn of the century and the world, 6.1 billion. These figures represent increases of 30 million and 1.4 billion, respectively.

From the global view, population change relative to available resources is probably the single most important trend influencing the demand on our forest resources. The world population in 1980 was approximately 4.4

billion people. United Nations projections indicate a range of levels at which world population will stabilize:

Low estimate 8.8 billion
by 2040

Medium estimate . . . 10.5 billion
by 2110

High estimate 14.2 billion
by 2130

Recent estimates of world population have been smaller than earlier ones. Although differing, they all lead to the conclusion that world population will approximately double over the next 50 years. Even if per-capita income remains constant, there will be need for more resources to feed, clothe, house, and nurture a population of this size.

Although experts may debate the actual magnitude of increase in demand for forest resources, no one denies that the increase will be substantial. Also, it seems inescapable that the competition for good land from agriculture, forestry, urbanization, and improving infrastructure must increase.

● **Per-capita real income will increase with a concomitant expansion in the demand for forest resources.**

A look at past growth in per-capita gross national product as a rough measure of increasing welfare of a nation may serve as an indicator of economic growth trends. In the United States, for example, gross national product will reach about \$2,690 billion (1972 dollars) by the year 2000, double what it was in 1977. The rate of growth worldwide is more rapid than that of the United States. Not only more people but more people with purchasing power greater than that of today can be anticipated.

As one example of the impact of this growth on our forest resources, the Forest Service estimates, in *An Assessment of the Forest and Rangeland Situation in the United States*,

the following increases in consumption of forest-based goods and services between 1978 and 2000: Downhill skiing 75 percent; timber 65 percent; freshwater fishing 40 percent; dispersed camping 35 percent; and water 25 percent.

For resources such as timber and water, the rates of growth for the rest of the world will be considerably greater than those for the United States.

● **Maldistribution of resources will lead to severe scarcity in some countries and increase the need for international trade.**

It is difficult even for the well-informed to reach a reasonable conclusion about the magnitude of possible world shortages of natural resources in the near future. Is the world running out of wood, oil, ground water, tillable soil, or strategic minerals? Is population growth outstripping our ability to feed, clothe, and house that population?

Do not look for a simple answer. The pessimists are concerned about pending world resource shortages, and the optimists see no immediate problem of meeting our food and fiber needs.

All parties agree, however, that population growth and resource availability do not match geographically. In many instances, the resources are not located where the people are. There is maldistribution of resources both within and among countries.

What does this imply about the demand for U.S. forest resources? It is obvious that countries will produce and market those things that they can do best and cheapest, or, in the economist's terms, for which they have a comparative advantage. Several trends suggest a shift towards countries such as the United States having a growing comparative advantage at both ends of the economic spectrum—basic resource activities such as agriculture and forestry and

the high-technology and information sectors.

- (1) The largest component of economic growth in Western Europe and the United States has been and will continue to be in the information and service sectors. Some have gone so far as to call this the beginning of the end of the industrial age in the Western World.
- (2) Technological advancements will make smaller manufacturing plants competitive and more available to the developing world.
- (3) Differentials in wage rates between low-income and developed nations will become even greater than they are today, driving labor-intensive industries toward the developing nations.
- (4) Countries with low-density populations, productive soils, and moderate climates will supply an increasingly larger share of the total world food and fiber supply.

One implication of these trends is that countries like the United States may supply a relatively larger share of basic agricultural and forest resources along with an increased share of the service sector, while countries earlier classified as medium or low income will supply relatively more manufactured goods than they have in the past. The magnitude of these shifts will be influenced more by political than economic affairs. Whatever the changing role of countries and regions, the demand for U.S. forest resources will increase significantly. Only the magnitude is debatable.

● **Technological advances will exert a major influence on both products desired and their supply at reasonable costs.**

Technological change occurs on a daily basis, usually in such incremental ways that it is not obvious, except perhaps when a Sputnik circles the globe or a lunar module lands on the moon. So why be concerned

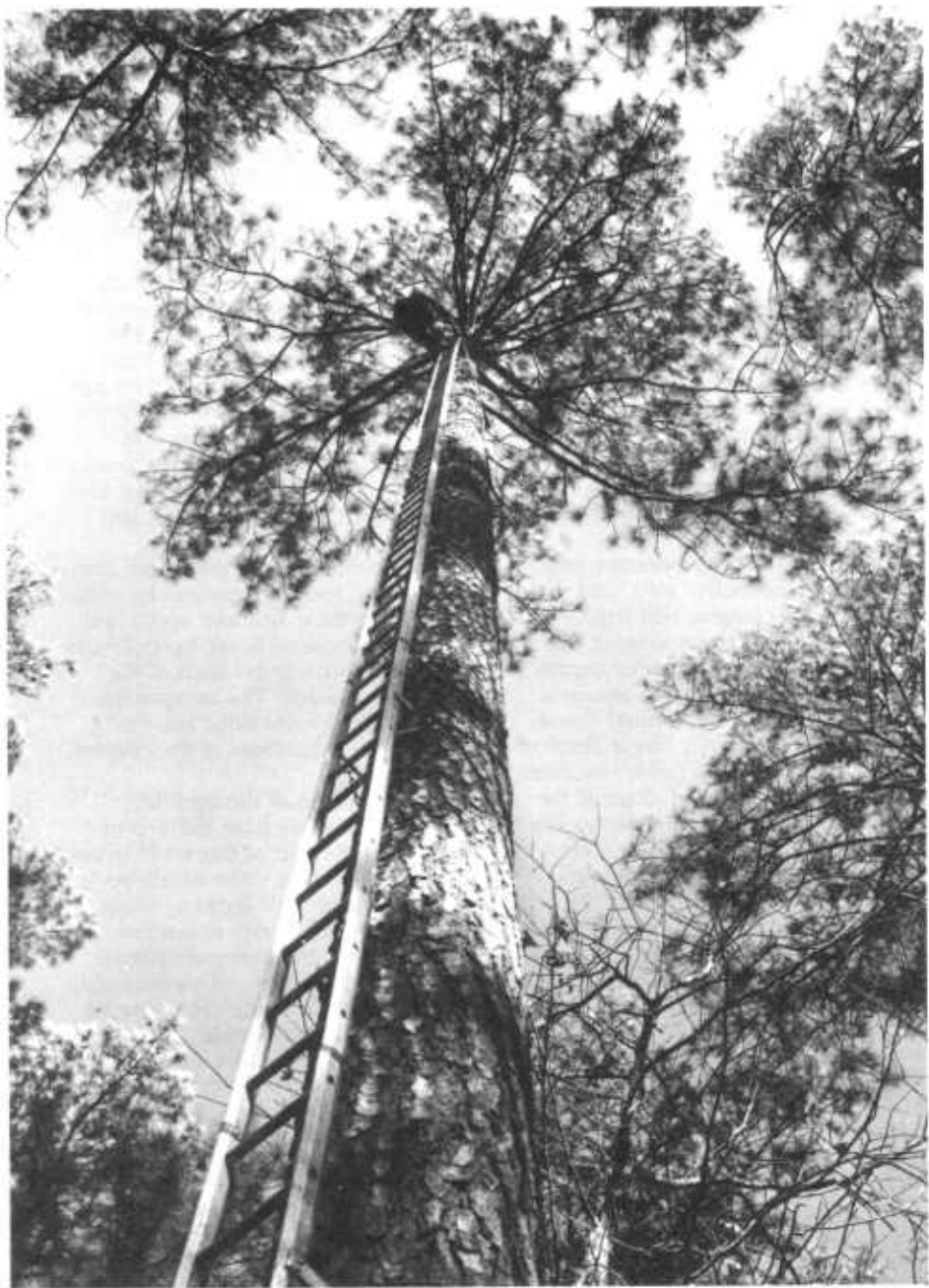
about technology? Certainly, this Nation has shown it can adapt to change. But to consider the development potential of forestry, there is a need to look beyond the end of the century—to perhaps 30, 40, or 50 years from now. In that period, technological changes could be so far reaching it could cause major economic and social change.

It is difficult to point out specific technological breakthroughs possible in the next few decades. Still, three broad areas undoubtedly will have major impacts on forestry and its role in development. They are: telematics (changes in communication and manufacturing related to advances in computers), genetic engineering, and technology related to resource and product substitution.

The combination of television, computer chip, and transmission by satellite will produce dramatic social and economic impacts. Some have already been felt. Virtually no areas of the world are isolated. The inexpensive transistorized radio alone has expanded the aspirations of the peoples of the world.

The definition of the good life, which earlier may have differed totally from one part of the world to another, has become more nearly homogenized through learning about each other. The desire to acquire more goods is becoming ubiquitous. One impact of advanced telecommunications is to stimulate the desire for material goods worldwide.

At the same time that advances in telecommunications increase the demand for material goods, telecommunications will be a major contributor in improving the domestic ability to supply those goods. The time needed to spread technology will be decreased severalfold. Whether our problems are agricultural, industrial, or health related, the prospect of using a global electronic extension service to solve them during our lifetime



A field technician high in this genetically superior loblolly pine collects cones for seed for tree breeding experiments.

is almost assured. Access to information is no longer limited to the few but becomes available to many, transported at the speed of 186,000 miles per second.

A third impact of the computer chip is its influence on heavy industry. Advances in telecommunications, improved sensors, robotics, and other electronically driven devices will yield equipment cheaper and more mobile than mechanical and hydraulic predecessors. The combination of increased demand for material goods, improved information on available technology, and less costly, smaller scale manufacturing possibilities will promote tremendous economic development over the next several decades.

Another area of technological change that will have major impacts on forestry is advanced genetic engineering. Although genetic engineering is still in its infancy, it has grown far beyond the walls of the academic laboratory. In the United States, several hundred commercial firms have been incorporated to research and sell the results of genetic engineering.

In forestry the first breakthroughs are likely to be in the area of pest control—biological insecticides, pest-resistant trees, and so forth. In the longer run, however, there is every reason to believe that trees with combinations of characteristics unheard of in nature will be planted and managed.

Besides the direct impacts of genetic engineering of forest plants, indirect effects, through reduced land and capital requirements to accommodate improved agriculture, could be significant. For example, breeding grain crops that can better withstand stress from either drought or temperature extremes could significantly increase the effective climatic range of grain crops, brightening the picture for human nutrition in the decades ahead.

A third kind of technological im-

provement that will exert an impact on forestry is advances in understanding the physical and chemical attributes of wood and wood fiber. Unleashing this knowledge will lead to moving away from the use of wood in traditional forms that required many trees of large size to produce solid wood products.

Use of reconstituted materials to replace lumber and plywood, paper processes that are less demanding on species mix for raw materials, expanded use of trees for chemicals, and expanded use of nontraditional species such as guayule will all be commercially common within the next couple of decades.

Critical Environmental Trends at Hand

These trends include tropical deforestation, desertification, and atmospheric deposition. Briefly, on each of these issues there is controversy over the present and future magnitude of the problem, its cause, and its impact. Although there may be debate over each of these, however, the focal point of environmental concerns on a global basis is directly related to the potential role of forestry as a tool for economic development. Although the magnitude of these concerns is arguable, they cannot be ignored.

Tropical Deforestation. The rate of harvesting commercial timber, converting forest land to agriculture, and cutting wood for fuel has exceeded the rate of natural or artificial regeneration of forests in the tropics. The *World Conservation Strategy* published in 1980 by the International Union for Conservation of Nature and Natural Resources (IUCN) cites the following:

An extreme view of the tropical deforestation issue is that at the current rate of felling and burning, this forest type will have disappeared within 85

Region	Total Closed Forests		Operable Hardwood Forests	
	Area projected to be lost 1975-2000	Percentage of 1975 area	Area projected to be lost 1975-2000	Percentage of 1975 area
	(1,000 ha)	Percent	(1,000 ha)	Percent
West Africa	6,600	47.1	6,600	54.7
Centrally planned tropical Asia	6,300	29.1	6,600	35.7
South Asia	16,400	23.0	13,600	27.9
East Africa and Asia	3,300	17.8	3,200	50.4
Insular Southeast Asia	21,600	16.5	20,000	26.3
Central America	10,900	13.4	4,600	23.9
Tropical South America	64,200	12.0	57,300	13.3
Continental Southeast Asia	4,100	10.6	4,000	13.3

years. In contrast, Sedjo and Clawson¹ claim, "The data suggest little possibility of the world running out of forests or even of major regions being dramatically denuded in any reasonable time horizon. However, there may be excessive rates of deforestation occurring in certain regions, particularly in some tropical areas."

Like most conclusions drawn on a global basis, this misses the more important point that variation between countries is tremendous. Many tropical countries will have major shortages of wood in the near future if limitations on clearcutting do not receive immediate attention. In some areas the problems are acute, the solutions are both difficult and costly, and the problem will continue for several decades.

Desertification. A counterpart to the issue of tropical deforestation is reduction of vegetation on drylands, where animals and plants live under stress from low rainfall and high evapotranspiration. According to IUCN, de-

sertification currently threatens the welfare of 628 million people. "Regions already in the grip of desertification or at high to very high risk cover . . . an area twice the size of Canada."

The impacts of desertification are, of course, reduced food supply, elimination of locally available fuel, and siltation of waterways and reservoirs.

The relationship between desertification and development is insidious. Most of the countries classified by the United Nations as least developed are found in two areas called the poverty belts. One of these stretches across Africa from the Sahara to Lake Nyasa. The other area ranges from Afghanistan to South Asia including parts of Burma, Cambodia, Vietnam, and India. Much of these two belts lies in arid areas, which are most sensitive to misuse of the land and ultimately desertification.

The United Nations Conference on Desertification held in Nairobi in 1977 devised a plan to deal with the many ramifications of both prevention

and rehabilitation of dryland areas. To date, progress in implementing that plan has not kept pace with the pressures on these lands. This problem too will remain well beyond the year 2000.

Atmospheric Deposition. Recently, much is being heard about decline in the vigor and growth of forests in North America and Western Europe. Little is known about this phenomenon, but it is being attributed to atmospheric pollution. The impacts of acidic deposition on plants range from interference with reproductive processes to increased susceptibility to stress and to damage to leaf surfaces and tissues that ultimately affect growth rates.

Although there has been documented evidence of reduced growth in forests and simultaneous mortality of all age classes of trees in a region, scientists disagree on the cause and effect and the potential magnitude of the problem. If the condition of forests in parts of Germany, Austria, and Switzerland declines further and if the decline expands into neighboring countries and in North America, this condition could have significant impact on wood supply, prices, and international trade.

It is impossible to predict the path this condition will take in the future, but, if there are potential wood-supply shortage problems in the future, they can only be exacerbated by forest decline resulting from atmospheric deposition. This problem has received much attention from the press. If a cause-and-effect relationship is convincingly illustrated, legal measures will likely be instituted fairly quickly.

Research—the Key to Expanding Forest Resources

Two conclusions from the previous trends are inescapable:

First, the world demand on forest resources will increase. Second, the United States, along with others, will play a critical role in meeting this demand. Yet if past trends in the supply of U.S. forest resources continue, the United States will fall short in its ability to meet this need. In fact, it will fall short in its ability to meet even domestic requirements without substantial increases in prices unless, as a nation, attention is turned to the improved management of our forests.

While much can be done through more intensive application of existing technology, there is also a need for research aimed at improving the availability of forest resources over time.

Three areas of research can significantly improve the availability of forest resources at reasonable prices.

The first area is that directly related to the improvement of growth of forest stands. This ranges from improvements in regeneration techniques to improve survival of young trees to development of improved genetic stock and to improved prevention of damage from fire and insect and disease pests. Gains from developing and planting genetically improved stock, for example, would increase timber yield per acre by about 25 percent over current rates of growth.

A second area of research deals with advances in the products manufactured from forest resources. Here the potential is limited only by the vision of the researchers. Substantial improvement in reducing the susceptibility of wood to decay could improve the useful life of products from housing to utility poles. Particularly exciting is the prospect of using wood as a basis for chemical feedstocks that would replace nonrenewable resources. Alcohol and other potential fuels are already being made from wood. Research is needed to make these processes economically competitive.



A research technician determines the pH of a lake in a study of the effect of acid precipitation on inland waters.

The third major area of research deals with understanding the impacts of nonforestry-related activities on forest land. Better techniques are needed for decreasing the impacts of tourism on the landscape while improving the recreation experience.

Already, interesting and productive work is being done on developing a better understanding of the effects of acid rain. This work will undoubtedly lead to solutions for mitigating the impact of this byproduct of industrial growth.

The direct and indirect impacts on our forest from an increasing population—more mobile, more industrial, more urban—cry out for the application of imaginative approaches to using and protecting our valuable forest resources. Through research and wise management, this cherished portion of our landscape will serve us well through future decades.

¹Sedjo, Roger A. and Marion Clawson. *Global Forests*. (Unpublished discussion paper.) Resources for the Future, Washington, DC. 1983.

Forest Biology Research and the 21st Century

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The modern forest manager must be increasingly sensitive to society's changing view of the forest resource. As lands that were forest are devoted to other uses such as agriculture or roads, the forest land base grows smaller. Yet the outlook is not bleak. Much of our forested land is producing at only 30 percent of its capability. So even in the face of declining forest acreage, there is plenty of room for improvement in the use of the land now growing trees. New forest products, such as flakeboard, use trees or parts of them once thought of as waste. Possibly just as important, research is providing new tools that will increase the efficiency of forest management.

New management direction from an enlightened, concerned populace, new uses for forest products, and new management tools, taken together, suggest that the 21st century will be the age of scientific, comprehensive forest management in the United States.

Selective Tree Breeding

For about 60 years scientists have been studying the genetic makeup of forest trees in the hope of learning how to breed them for faster growth, improved wood quality, improved species adaptability, and greater resistance to disease. Several break-